Two-Dimensional Imaging of Soot Volume Fraction in Laminar Diffusion Flames

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Abstract

A technique for acquiring two-dimensional soot-volume-fraction measurements in laminar flames has been demonstrated. The technique provides a map of very low noise concentration over a range of wavelengths (250-1100 nm). A noise level of 0.0007 in extinction and a spatial resolution of 30-40 mu m for soot concentration were achieved with an are lamp source that was filtered to provide greater spatial coherence and a CCD detector. The broadband are lamp source also allowed us to avoid the added noise resulting from speckle with coherent laser sources. Beam steering, due to refractive-index gradients in the flame, was measured and compared with theoretical predictions. The optical arrangement to minimize the effect of beam steering is described. As a result the beam steering had no effect on the soot measurements in the dames examined. Flame-transmission maps obtained with this system in an ethylene/air laminar diffusion flame are presented. Tomographic analysis from use of an Abel inversion of the line-of-sight data to obtain radial profiles of soot concentration is described.